

Application No.: 09/436,637

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AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all prior versions and listings:

1. (Previously Presented) A chemical supply system for supplying a mixture solution to a chemical treatment chamber, wherein said mixture solution includes a liquid chemical mixed and diluted with a solvent, said chemical supply system comprising:
 - at least one chemical reservoir that is easy to carry, wherein said liquid chemical is stored in said chemical reservoir at a high concentration;
 - a piping system in which said solvent flows, wherein said piping system includes a discharge portion for said mixture solution at an end portion thereof; and
 - a chemical supply means for feeding out a predetermined quantity of said liquid chemical from said chemical reservoir into a connecting pipe;
 - a chemical discharging means connecting said connecting pipe to said piping system and arranged to discharge said liquid chemical from said connecting pipe into said solvent in the piping system at a linear velocity that is significantly greater than a linear velocity of said solvent to produce said mixture solution at a described uniform concentration.
2. (Previously Presented) The chemical supply system of claim 1, wherein:
 - said chemical supply means is a chemical supply pump including a flow passage for passing a predetermined liquid chemical;
 - a suction valve which is closed by a pressure rise of said liquid chemical is provided at a flowing-in port of said flow passage, and a discharge valve which is closed by a pressure fall of said liquid chemical is provided at a flowing-out port of said flow passage;
 - said flow passage includes a liquid contact surface, at least part of is made of a compact member with non-permeability and a high anti-corrosion property with respect to said liquid chemical, part of said compact member being made into a movable wall; and
 - a shaker is connected to said movable wall, said movable wall being oscillated in a direction substantially perpendicular to a surface of the movable wall by driving said shaker to periodically change the volume of said flow passage.
3. (Previously Presented) The chemical supply system of claim 1, wherein said

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chemical supply means comprises:

a first pump for feeding out said liquid chemical from said chemical reservoir, and
a second pump for storing said liquid chemical fed out from said first pump and
supplying a predetermined quantity of said liquid chemical to said piping system by applying a
predetermined pressure to said liquid chemical for a predetermined time.

4. (Previously Presented) The chemical supply system of claim 3, wherein said
second pump comprises:

a chemical storage means in which said liquid chemical is stored;
a pressure control means for performing pressure control by feeding a gas to said liquid
chemical in said chemical storage means; and
a liquid level measurement means for measuring a change in liquid quantity of said liquid
chemical in said chemical storage means, wherein said pressure control means is controlled on
the basis of a measurement result of said liquid level measurement means, and wherein a
predetermined quantity of said liquid chemical is supplied to said piping system.

5. (Previously Presented) The chemical supply system of claim 1, wherein said
chemical supply means is a pump, said chemical supply system further comprising a cooling
means for cooling an interior of said pump and an interior of a piping portion between said
chemical reservoir and said pump relative to a temperature of the liquid chemical.

6. (Previously Presented) The chemical supply system of claim 3, wherein said
shaker is controlled such that the absolute value of a negative pressure at the time of sucking said
liquid chemical in one period of oscillation is as small as possible and suction time is longer than
discharge time when said shaker oscillates and drives said movable wall.

7. (Previously Presented) The chemical supply system of claim 1, further comprising
a degassing tube disposed between said chemical reservoir and said chemical supply means,
wherein said degassing tube includes a surface layer that is a degassing membrane, wherein said
liquid chemical is passed through said degassing tube in a state that an external pressure of said

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degassing tube is lower than an internal pressure of said degassing tube, and degassing of said liquid chemical is performed.

8. (Previously Presented) The chemical supply system of claim 1, wherein said chemical discharging means comprises a capillary disposed in said connecting pipe.
9. (Previously Presented) The chemical supply system of claim 1, further comprising a control system for regulating said mixture solution supplied from said discharge portion.
10. (Previously Presented) The chemical supply system of claim 9, further comprising:
 - a flow rate regulation means for regulating a flow rate of said solvent or said liquid chemical passing through said piping system;
 - a concentration regulation means for regulating a concentration of said mixture solution passing through said piping system; wherein said control system has a chemical supply control means for regulating a supply quantity of said liquid chemical to said solvent of said chemical supply means, wherein said control system has a concentration control means for driving said concentration regulation means, wherein said chemical supply control means drives said flow rate regulation means, wherein said chemical supply control means and said concentration control means are connected, and wherein a result of concentration control by said concentration control means is fed back to said chemical supply control means to regulate the supply quantity of said liquid chemical.
11. (Previously Presented) The chemical supply system of claim 1, further comprising a mixing means for producing a rotational flow in said mixture solution to stir and uniformize said mixture solution;
 - wherein said mixing means has a spiral pitch in a flow passage for said mixture solution, and a rotational flow is produced by said mixture solution passing through said pitch.
12. (Previously Presented) The chemical supply system of claim 1, further comprising a mixing means for producing a rotational flow in said mixture solution to stir and

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uniformize said mixture solution;

wherein said mixing means includes a flowing-in portion and a flowing-out portion that are slightly offset.

13. (Previously Presented) The chemical supply system of claim 1, wherein:

said chemical reservoir includes a main reservoir in which a sufficient quantity of said liquid chemical is stored, and an auxiliary reservoir connected to said main reservoir and to which only a necessary quantity of said liquid chemical is supplied from said main reservoir; and

said auxiliary reservoir has a liquid surface level regulation means for regulating a liquid surface level of said liquid chemical supplied to control a chemical quantity in said chemical reservoir.

14. (Previously Presented) The chemical supply system of claim 1, wherein said liquid surface level regulation means comprises a pair of bar-like sensors made of conductive members, and wherein said liquid surface level regulation means calculates said liquid surface level and a changing speed thereof by measuring an electrostatic capacity of portions of said bar-like sensors dipped in said liquid chemical and a change of said electrostatic capacity over time.

15. (Previously Presented) The chemical supply system of claim 1, further comprising:

a connecting flow passage connecting said piping system and said chemical supply means;

a connecting tube branching from a portion of said piping system upstream of said connecting flow passage, wherein said connecting tube is connected to said chemical supply means to form a closed system, and wherein said solvent flows in said closed system to defoam when said chemical reservoir is unused.

16. (Withdrawn) A substrate cleaning apparatus in which a cleaning liquid is supplied to a set substrate to clean, characterized by comprising
a chemical supply system comprising

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at least one kind of chemical reservoir easy to move, in which said liquid chemical at a high concentration is stored,

a chemical supply means for sucking a predetermined quantity of said liquid chemical from said chemical reservoir and feeding out it, and

a piping system forming a flow passage for said solvent connected to said chemical supply means, and having a discharge portion for said solution at an end portion,

wherein, at the time of use, a necessary quantity of said liquid chemical is mixed and diluted with said solution flowing in said piping system, said mixture solution at a desired concentration is produced, and said mixture solution is supplied from said discharge portion,

said mixture solution being used as said cleaning liquid.

17. (Withdrawn) A chemical supply pump in which a flow passage for passing a predetermined liquid chemical is formed, a suction valve which is closed by pressure rise of said liquid chemical is provided at a flowing-in port of said flow passage, and a discharge valve which is closed by pressure fall of said liquid chemical is provided at a flowing-out port of said flow passage, characterized in that

at least part of a liquid contact surface in said flow passage is made of a compact member with non-permeability and a high anti-corrosion property to said liquid chemical, and part of said compact member is made into a movable wall, and

a shaker connected to said movable wall is provided, and said movable wall is oscillated in a direction substantially perpendicular to its wall surface by drive of said shaker to change the volume of said flow passage periodically.

18. (Withdrawn) A chemical supply pump described in claim 17, characterized in that said compact member is conductive.

19. (Withdrawn) A chemical supply pump described in claim 18, characterized in that said conductive compact member is made of amorphous carbon.

20. (Withdrawn) A chemical supply pump described in claim 17, characterized in that said compact member is made of ceramics or sapphire.

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21. (Withdrawn) A chemical supply pump described in claim 17, characterized by comprising a drive transmission means for transmitting oscillation from said shaker to said movable wall, between said movable wall and said shaker.

22. (Withdrawn) A chemical supply pump described in claim 21, characterized by comprising an elastic means for elastically biasing said drive transmission means.

23. (Withdrawn) A chemical supply pump described in claim 21, characterized in that said shaker is a piezoelectric oscillator for oscillating said movable wall by piezoelectric transduction.

24. (Withdrawn) A chemical supply pump described in claim 18, characterized in that an opposite wall constituting at least part of said liquid contact surface opposite to said movable wall is made of said conductive compact member, and the electrostatic capacity of a capacitor formed by said movable wall and said opposite wall sandwiching, as a dielectric substance, said liquid chemical passing through said flow passage, is measured.

25. (Withdrawn) A chemical supply pump described in claim 17 characterized in that said movable wall has a shape that becomes thicker from the center to the periphery.

26. (Withdrawn) A chemical supply pump described in claim 21, characterized in that an auxiliary member for uniformly transmitting the pressure from said drive transmission means to said movable wall is provided between said movable wall and said drive transmission means.

27. (Withdrawn) A chemical supply pump described in claim 21, characterized in that, in said drive transmission means, in anticipation of reaction received from said liquid chemical when a direct oscillation transmission portion to said movable wall is pressed, said oscillation transmission portion and the portion where said reaction is great are formed to be

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thicker.

28. (Withdrawn) A chemical supply pump described in claim 17, characterized in that a gas ventilation system including corner portions which are liquid contact portions of said flow passage and said liquid chemical

is apt to stay in, and low-corrosion property portions to said liquid chemical, is provided, and a predetermined gas is passed through said gas ventilation system.

29. (Withdrawn) A chemical supply pump described in claim 28, characterized in that said corner portions and said low-corrosion property portions include at least the periphery of each of said suction valve, said discharge valve, and said movable wall.

30. (Withdrawn) A chemical supply pump described in claim 17, characterized in that a cooling means for cooling the interior of said flow passage relatively to the chemical temperature, is provided.

31. (Withdrawn) A chemical supply pump described in claim 17, characterized in that said shaker controls such that the absolute value of a negative pressure at the time of sucking said liquid chemical in one period of oscillation is as small as possible and the suction time is longer than the discharge time when it oscillates and drives said movable wall.

32. (Withdrawn) A chemical supply apparatus characterized by comprising
a chemical supply pump, and
a connecting flow passage connecting a supply flow passage that is a passage for a solvent with which said liquid chemical is mixed, and said chemical supply pump,
wherein a tubule member directly connecting said supply flow passage is provided in said connecting flow passage, and,
in said chemical supply pump,
a flow passage for passing a predetermined liquid chemical is formed, a suction valve which is closed by pressure rise of said liquid chemical is provided at a flowing-in port of said flow passage, and a discharge valve which is closed by pressure fall of said liquid chemical is

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provided at a flowing-out port of said flow passage,

at least part of a liquid contact surface in said flow passage is made of a compact member with non-permeability and a high anti-corrosion property to said liquid chemical, and part of said compact member is made into a movable wall,

a shaker connected to said movable wall is provided, and said movable wall is oscillated in a direction substantially perpendicular to its wall surface by drive of said shaker to change the volume of said flow passage periodically, and,

by drive of said chemical supply pump, said liquid chemical is discharged from said tubule member into said solvent passing through said supply flow passage to compound a mixture solution at a desired concentration.

33. (Withdrawn) A chemical supply apparatus described in claim 32, characterized in that the discharge direction

of said liquid chemical is a direction substantially perpendicular to the flow direction of said solvent, and

said chemical supply pump gives said liquid chemical a pressure such that the linear velocity of said liquid chemical discharged from said tubule member is greater than the linear velocity of said solvent passing through said supply flow passage.

34. (Withdrawn) A chemical supply apparatus described in claim 32, characterized in that an electrode surrounding part of said connecting flow passage is provided, and the electrostatic capacity of said liquid chemical passing through said connecting flow passage is measured by said electrode.

35. (Withdrawn) A chemical supply apparatus described in claim 32, characterized by comprising a chemical discharge stop means surrounding part of said connecting flow passage near said tubule member,

said chemical discharge stop means operating so as to suck some quantity of said solvent in said supply flow passage from said tubule member synchronously with stop of said chemical supply pump.

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36. (Withdrawn) A chemical supply apparatus described in claim 35, characterized in that said chemical discharge stop means has an electric heating system for heating said liquid chemical to a predetermined temperature, and heating by said electric heating system is stopped synchronously with stop of said chemical supply pump.

37. (Withdrawn) A chemical supply apparatus described in claim 35, characterized in that said chemical discharge stop means has a compression system, and drives synchronously with stop of said chemical supply pump.

38. (Withdrawn) A chemical supply apparatus described in claim 32, characterized by comprising a chemical discharge stop means which is directly connected to part of said connecting flow passage near said tubule member, and comprises another tubule member connected to a portion corresponding to the upstream of said solvent of the connection portion of said tubule member of said supply flow passage,

said chemical discharge stop means operating so as to supply said solvent from said other tubule member into said supply flow passage synchronously with stop of said chemical supply pump, and to push out said liquid chemical remaining in said connecting flow passage to said supply flow passage side by an action of a check valve provided on said chemical supply pump side.

39. (Withdrawn) A chemical supply apparatus described in claim 38, characterized in that a check valve is provided near an inlet of said other tubule member, and the concentration change of said liquid chemical is made minimum.

40. (Withdrawn) A chemical supply apparatus described in claim 32, characterized in that said tubule member has an electric heating system for heating said liquid chemical to a predetermined temperature, and heating by said electric heating system is stopped synchronously with stop of said chemical supply pump to suck some quantity of said solvent in said supply flow passage.

41. (Withdrawn) A chemical supply apparatus described in claim 32, characterized in

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that a pair of temperature detection elements is embedded near the connection portion to said supply flow passage of said tubule member, and

the temperature difference between said temperature detection elements is detected synchronously with said chemical supply pump, and the flow condition of said mixture solution is monitored.

42. (Withdrawn) A chemical supply apparatus described in claim 32, characterized in that said solvent is ultrapure water.

43. (Withdrawn) A chemical supply apparatus described in claim 32, characterized in that said tubule member is conductive.

44. (Withdrawn) A chemical supply apparatus described in claim 43, characterized in that said tubule member is made of amorphous carbon.

45. (Withdrawn) A chemical supply system comprising
at least one kind of chemical reservoir easy to move,
a chemical supply apparatus connected in correspondence to said chemical reservoir, and
said supply flow passage,
said chemical supply apparatus comprising
a chemical supply pump, and
a connecting flow passage connecting the supply flow passage that is a passage for a
solvent with which said liquid chemical is mixed, and said chemical supply pump,
wherein a tubule member directly connected to said supply flow passage is provided in
said connecting flow passage, and,
in said chemical supply pump,
a flow passage for passing a predetermined liquid chemical is formed, a suction valve
which is closed by pressure rise of said liquid chemical is provided at a flowing-in port of said
flow passage, and a discharge valve which is closed by pressure fall of said liquid chemical is
provided at a flowing-out port of said flow passage,
at least part of a liquid contact surface in said flow passage is made of a compact member

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with non-permeability and a high anti-corrosion property to said liquid chemical, and part of said compact member is made into a movable wall, and

a shaker connected to said movable wall is provided, and said movable wall is oscillated in a direction substantially perpendicular to its wall surface by drive of said shaker to change the volume of said flow passage periodically,

said chemical supply apparatus discharging said liquid chemical from said tubule member into said solvent passing through said supply flow passage by drive of said chemical supply pump to compound a mixture solution at a desired concentration,

said chemical supply system being characterized by discharging said mixture solution made into the predetermined concentration from a discharge portion provided at an end portion of said supply flow passage, by drive of said chemical supply pump of said chemical supply apparatus.

46. (Withdrawn) A chemical supply system described in claim 45, characterized by comprising a control system for regulating said mixture solution supplied from said discharge portion.

47. (Withdrawn) A chemical supply system described in claim 46, characterized by comprising
a flow rate regulation means for regulating the flow rate of said solvent or said liquid chemical passing through said supply flow passage, and
a concentration regulation means for regulating the concentration of said mixture solution passing through said supply flow passage,

wherein said control system has a chemical supply control means for regulating the supply quantity of said liquid chemical to said solvent of said chemical supply pump, and a concentration control means for driving said concentration regulation means,

said chemical supply control means drives said flow rate regulation means,
said chemical supply control means and said concentration control means are connected, and a result of concentration control by said concentration control means is fed back to said chemical supply control means to regulate the supply quantity of said liquid chemical.

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48. (Withdrawn) A chemical supply system described in claim 45, characterized by comprising a mixing means for producing a rotational flow in said mixture solution to stir and uniformize said mixture solution,
wherein said mixing means has a spiral pitch in a flow passage for said mixture solution, and a rotational flow is produced by said mixture solution passing through said pitch.

49. (Withdrawn) A chemical supply system described in claim 45, characterized by comprising a mixing means for producing a rotational flow in said mixture solution to stir and uniformize said mixture solution,
wherein, in said mixing means, a flowing-in portion to said mixing means in said supply flow passage and a flowing-out portion are provided to be slightly offset.

50. (Withdrawn) A chemical supply system described in claim 45, characterized in that said chemical reservoir is constructed by having a main reservoir in which a sufficient quantity of said liquid chemical is stored, and an auxiliary reservoir which is connected to said main reservoir and only a necessary quantity of said liquid chemical is supplied to from said main reservoir, and
said auxiliary reservoir has a liquid surface level regulation means for regulating the liquid surface level of said liquid chemical supplied to control said chemical quantity.

51. (Withdrawn) A chemical supply system described in claim 50, characterized in that said liquid surface level regulation means is a pair of bar-like sensors made of conductive members, and calculates said liquid surface level and the changing speed thereof by measuring the electrostatic capacity of the dipped portions of said bar-like sensors in the liquid chemical and its change over time.

52. (Withdrawn) A chemical supply system described in claim 45, characterized in that said supply flow passage has a connecting tube branching from a portion corresponding to the upstream of said solvent of the connection portion to said tubule member, said connecting tube is connected to said chemical supply pump to form a closed system, and,
when said chemical reservoir is unused, said solvent is made to flow in said closed

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system to defoam.

53. (Withdrawn) A chemical supply system described in claim 45, characterized in that a plurality of said chemical supply apparatus is connected to said chemical reservoirs in correspondence to a plurality of said chemical reservoirs in each of which a predetermined liquid chemical is stored, and

said chemical supply apparatus are arbitrarily driven to mix said liquid chemicals with said solvent passing through said supply flow passage, in a desired order.

54. (Withdrawn) A chemical supply system described in claim 45, characterized in that a degassing tube whose surface layer is a degassing film is provided between said chemical reservoir and said chemical supply pump, said liquid chemical is passed through said degassing tube in a state that the external temperature pressure of said degassing tube is low, and degassing of said liquid chemical is performed.

55. (Withdrawn) A substrate cleaning apparatus in which a cleaning liquid is supplied to a set substrate to clean, comprising a chemical supply system,

said chemical supply system comprising

at least one kind of chemical reservoir easy to move,

a chemical supply apparatus connected in correspondence to said chemical reservoir, and

a supply flow passage,

said chemical supply apparatus discharging said liquid chemical from said tubule member into said solvent passing through said supply flow passage by drive of said chemical supply pump to compound a mixture solution at a desired concentration, comprising

a chemical supply pump, and

a connecting flow passage connecting the supply flow passage that is a passage for a solvent with which said liquid chemical is mixed, and said chemical supply pump, wherein a tubule member directly connected to said supply flow passage is provided in said connecting flow passage, and,

in said chemical supply pump,

a flow passage for passing a predetermined liquid chemical is formed, a suction valve

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which is closed by pressure rise of said liquid chemical is provided at a flowing-in port of said flow passage, and a discharge valve which is closed by pressure fall of said liquid chemical is provided at a flowing-out port of said flow passage,

at least part of a liquid contact surface in said flow passage is made of a compact member with non-permeability and a high anti-corrosion property to said liquid chemical, and part of said compact member is made into a movable wall, and

a shaker connected to said movable wall is provided, and said movable wall is oscillated in a direction substantially perpendicular to its wall surface by drive of said shaker to change the volume of said flow passage periodically,

said substrate cleaning apparatus being characterized by using said mixture solution as said cleaning liquid.

56. (Withdrawn) A substrate cleaning apparatus described in claim 55, characterized by being a substrate single wafer spin cleaning apparatus in which substrates are loaded one by one, and said cleaning liquid is supplied with rotating the substrate in a circumferential direction.

57. (Withdrawn) A chemical supply method using a chemical supply pump, characterized in that,

in said chemical supply pump,
a flow passage for passing a predetermined liquid chemical is formed, a suction valve which is closed by pressure rise of said liquid chemical is provided at a flowing-in port of said flow passage, and a discharge valve which is closed by pressure fall of said liquid chemical is provided at a flowing-out port of said flow passage,

at least part of a liquid contact surface in said flow passage is made of a compact member with non-permeability and a high anti-corrosion property to said liquid chemical, and part of said compact member is made into a movable wall, and

a shaker connected to said movable wall is provided, and said movable wall is oscillated in a direction substantially perpendicular to its wall surface by drive of said shaker to change the volume of said flow passage periodically, and

said chemical supply pump is driven, and said liquid chemical is discharged into a solvent passing through said supply flow passage to compound a mixture solution at a desired

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concentration.

58. (Withdrawn) A chemical supply method described in claim 57, characterized in that the discharge direction of said liquid chemical is a direction substantially perpendicular to the flow direction of said solvent, and

said chemical supply pump gives said liquid chemical a pressure such that the linear velocity of said liquid chemical discharged from said tubule member is greater than the linear velocity of said solvent passing through said supply flow passage.

59. (Withdrawn) A chemical supply method described in claim 57, characterized in that the mixture solution made into the desired concentration is discharged from a solution supply port provided at an end portion of said supply flow passage.

60. (Withdrawn) A chemical supply method described in claim 57, characterized in that a plurality of said chemical supply pumps is used, and said chemical supply pumps are arbitrarily driven to mix said liquid chemicals with said solvent passing through said supply flow passage, in a desired order.

61. (Withdrawn) A substrate cleaning method in which a cleaning liquid is supplied to a set substrate to clean, characterized in that a chemical supply pump is used in which a flow passage for passing a predetermined liquid chemical is formed, a suction valve which is closed by pressure rise of said liquid chemical is provided at a flowing-in port of said flow passage, and a discharge valve which is closed by pressure fall of said liquid chemical is provided at a flowing-out port of said flow passage,

at least part of a liquid contact surface in said flow passage is made of a compact member with non-permeability and a high anti-corrosion property to said liquid chemical, and part of said compact member is made into a movable wall, and

a shaker connected to said movable wall is provided, and said movable wall is oscillated in a direction substantially perpendicular to its wall surface by drive of said shaker to change the volume of said flow passage periodically, and

said chemical supply pump is driven, said liquid chemical is discharged into a solvent

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passing through said supply flow passage, a mixture solution at a desired concentration is compounded, and said mixture solution is used as said cleaning liquid to clean said substrate surface.

62. (Withdrawn) A substrate cleaning method described in claim 61, characterized by using a substrate single wafer spin cleaning apparatus in which substrates are loaded one by one, and said cleaning liquid is supplied with rotating the substrate in a circumferential direction.

63. (Currently Amended) A chemical supply system for supplying a mixture solution for cleaning a substrate, wherein said mixture solution includes a liquid chemical mixed and diluted with a solvent, said chemical supply system comprising:

at least one chemical reservoir that is easy to move, wherein said liquid chemical is stored in said chemical reservoir at a high concentration;

a chemical supply means for sucking a predetermined quantity of said liquid chemical from said chemical reservoir and feeding said liquid chemical out;

a piping system connected to said chemical supply means and forming a flow passage in which said solvent flows, wherein said piping system includes a discharge portion for said mixture solution at an end portion thereof; and

a chemical discharging means arranged to discharge said liquid from said chemical supply means into said solvent in said piping system such that said mixture solution is produced at a desired concentration and is applied to the substrate without storing such that the mixture solution is prevented from being polluted.